

## **A SOFTWARE ARCHITECTURE FOR IMPLEMENTATION OF ERP IN HIGHER EDUCATION INSTITUTION**

**SUPRIHANTO & TRANSMISSIA SEMIAWAN**

Department of Computer Engineering & Informatics Bandung State Polytechnic  
Bandung, Indonesia

### **ABSTRACT**

Enterprise Resource Planning (ERP) is an integrated ICT based system which manages enterprise resources. It is also an application and software architecture which facilitates information flows between various business functions of an enterprise. ERP has been used for decades in many enterprises. However, it is seldom that ERP is implemented in higher education (HE) institutions, because the institutions are not considered as an 'enterprise' when running their HE businesses. Furthermore, usually HE institutions in Indonesia already has an integrated or unintegrated information system running. In HE institution with an unintegrated information system, sharing data between and within functional areas is hard. This leads to difficulties in resource planning, decision making, and difficulties in serving the institution's stakeholders effectively and efficiently. This paper discusses a study regarding the development of application software architecture for implementation of ERP in HE institutions in which many unintegrated information systems already running. The study focuses on one aspect of the ERP, i.e. education program planning. The study is performed in two phases. The first phase identifies the business process related with the education program planning. The second phase constructs a software architecture based on this business process. The study takes Politeknik Negeri Bandung (Bandung State Polytechnic) as a case study. But, due to its generic nature, the results could be implemented in other institutions as well.

**KEYWORDS:** HE Institution, ERP, Software Architecture

### **INTRODUCTION**

#### **Background**

Many HE institutions in Indonesia has already used various information systems for supporting activities of their functional areas. However, usually each of these information systems runs on its own and on different platform. These information systems could hardly communicate with each other. Data are scattered throughout functional areas. In this kind of environment, sharing data between functional areas is not easy, due to different format, different meaning, and different updates of same data. For example, in one system, a person name could be coded in two fields (first name and last name), while in other system it is coded in more than one field (first name, middle name, and last name). A same piece of data may have different time ranges. For example, in one system student attendance is calculated weekly, while in other system it is calculated monthly. A same piece of data may also defined differently. For example, in one system a course ID may contain department code, year, semester, and course number. While in other system it does not contain department code. Data integrity is not maintained. These conditions lead to difficulties in data consolidation, which in turn introduce problems in education program planning.

## Problem Statement

The same conditions happen in Politeknik Negeri Bandung (Bandung State Polytechnic). This institution uses Resources Management Information System, Accounting and Finance Information System, Academic Information System, and many others to support the running of its functional areas. Each information system runs on its own and on different platform. Sharing data between information systems and delivering data from one information system to another are not easy. Data are scattered throughout these systems. To collect and compile data required for education program planning needs a lot of effort. This research studies how to develop an ERP software architecture which integrates these information systems to support education program planning.

## Approach

It is not wise to terminate the existing information systems and build a new integrated one. Rather, it is better to develop interfaces between them. These interfaces should facilitate information flows between information systems and provide data consolidation function. The software architecture is built around this idea. It uses ETL (Extract, Transform, and Load) method to take or receive data from one information system, transform the data to suit the data requirements of the target information system, and deliver them.

The development of the software architecture is performed in two phases. The first phase identifies the business process related with the education program planning. The second phase constructs a software architecture based on this business process.

## Value of Research

The software architecture, although is developed based on the condition which exists in Bandung State Polytechnics, is built as generic as possible. The condition may varies between HE institutions, but the tasks performed by the ETL are similar, i.e. it retrieves or receives data from one information system, transform the data, and convey them to the other information systems or to users who need them. The data transformation could be concatenation, look-up, union, join, etc., depending on the condition of the source data and on the data requirements of the target database. So, as long as the software architecture provides a complete methods for data extraction, data transformation, and data transfer, it can be made general. Thus, it can be implemented as well in other HE institutions which have similar condition.

## LITERATURE REVIEW

Since its development in the beginning of 1990, ERP, as a solution software, has been implemented in many institutions or enterprises for supporting managerial functions such as financial, human resource, customer services, and manufacture production [1] [2]. However, of those HE institutions which have implemented the ERP, studies results show that there is not many which have been used ERP as a technology for supporting their operational management [3]. This is due to the fact that the environment of HE institution is not the same with those of a non-HE organizations. Abugabah\_Sanzogni [3], argues that HE institution has different environment and conditions with those of other organizations. In HE institution the management focuses on academic services.

Other than implementation in many organizations, ERP is also developed to improve the smoothness and efficiency of organization areas/functions work. A study performed by Mayed [4] shows that there are about 24 study area of ERP which have been researched. However, none of those area is related to implementation of ERP for integrated

management of resources in HE institution.

Other thing which is related to the study of ERP is that many researchers see that many of ERP implementation is not as expected. Davis\_Huang [2] shows that the failure of ERP implementation is about 50%-90% of the related implementation study. Abugabah-Sanzogni [3] argues that the primary cause of the ERP implementation failure is the absence of a comprehensive model which describes the business process of the organization for which its operational can be supported by ERP.

With the light from these previous researches, this research first identified the business process of the education program planning. Then, based on this business process a software architecture is defined.

## RESEARCH METHODS

This research constructed a business process model by reverse engineering of the existing information systems running in a HE institution, in this case Bandung State Polytechnic. Reverse-engineering is a process of “analyzing a subject system to create representations of the system at a higher level of abstraction” [5]. In accordance with Warden [6], the reverse engineering is performed starting with analyzing the existing programs codes of the various unintegrated information systems, exploring the way how the organization functions, and keep continuing until the existing business process model abstraction is obtained. Based on this business process model abstraction, a new software architecture is developed. This is the process of re-engineering [6]. The various existing unintegrated information systems are kept operational.

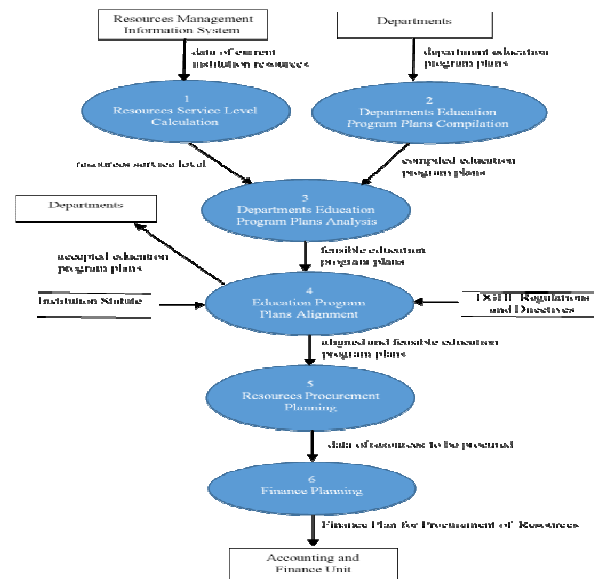
## RESULTS AND DISCUSSIONS

The business process scope of a HE institution may be very large. This research does not cover a comprehensive business process of a HE institution. Rather, it focuses on the business process around education program planning.

Businesses takes resources, such as material, people, and equipment, as inputs and transforms these inputs into goods and services for costumers [7]. In case of Polytechnic, it takes raw students as input and transforms them to produce the end product, i.e. professional graduates. During the process, it consumes material, uses equipment and infrastructures, and involves people, such as lecturers, instructors, and management staffs. Procurement of these resources are an important part of the education program planning [9].

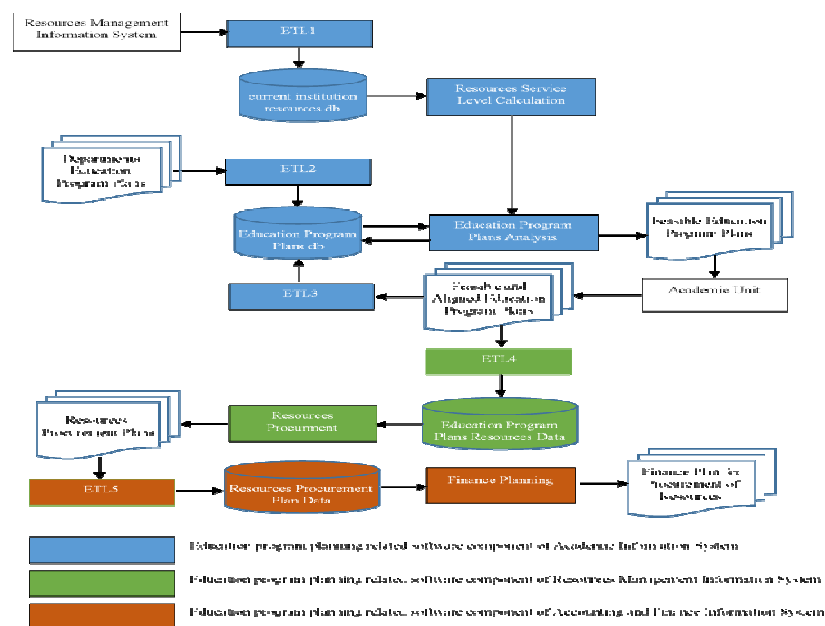
In Bandung State Polytechnic, the education programs planning is carried out mostly in bottom up fashion. That is, education program plan comes from the institution departments. The top level management then compile and analyze this plan according to the current resources service level, align it with the institution statute and the DGHE (Directorate General of Higher Education) regulations and directives, define the resources required for supporting the education program, and create a finance plan for procurement of the resources.

Figure 1 shows the business process.



**Figure 1: The Education Program Planning Business Process**

Figure 2 shows a software architecture for supporting the education program planning.



**Figure 2: A Software Architecture For Supporting Education Program Planning**

The business process involves Departments, Accounting and Finance Unit, Academic Unit, and three existing information system, i.e. Academic Information System, Resources Management Information System, and Accounting and Finance Information System. There is no online interaction mechanism between these entities. They define data, even for the same piece of data, differently. Communicating data between these entities is not an easy task. In the software architecture, to consolidate data needed for education program planning, an ETL is used (Figure 2). ETL has been around for decades. Usually it is used in data warehousing. It takes data from several heterogeneous sources, consolidate it, and put it in a data warehouse. Here, it is used as a glue for the unintegrated information systems.

The software architecture shows 5 ETLs. However, conceptually they provide similar functions. Which functions performed by each ETL depends on the nature of the source data and the data requirements of the target database. The various functions the ETL should provide are described below.

### **Data Extraction/Import**

- Extracting data from a relational database
- Importing data from files (flat files, csv files, spreadsheet files, XML files, binary files)
- Extracting data using a web service

### **Data Transformation**

- Selecting data
- Translating coded value
- Joining data
- Sorting data
- Transposing or pivoting data
- Aggregating and disaggregating data
- Validating data
- Look-up
- Encoding free-form values
- Calculating values
- Splitting data

### **Data Load**

- Loading transformed data into a target database

The advantage of using ETL, is that we do not have to reconstruct the existing databases. The transformation functions of the ETL can be used to provide data which suits the data requirements of the existing databases. Also, we do not have to build the ETL from scratch. There already exist many ETL packages, either the free ones from the open sources or the proprietary ones. Besides ETL, to integrate the information systems, we may also require a data communication infrastructure. It could be an internet infrastructure or an intranet infrastructure. If there is a need to extract data from a web environment, the ETL can still be used. There is a function in the ETL to extract data using a web service.

A web service is a collection of functions that perform certain tasks or retrieve certain data, exposed by a web interface to receive requests from web clients. The data is published using a collection of web services. The benefit of using a web service to get the data is that the source system can have a single, uniform mechanism to publish its data. All the consumers of this data are sure that the data they receive is consistent. [8]

## CONCLUSIONS

Many HE institutions in Indonesia have already used various information systems to support the running of activities of their functional areas. These information systems may not be integrated. There are alternatives for implementing ERP in this environment. We could throw away all the existing information systems and build an entirely new ERP systems, or we keep the existing information systems and provide some mechanisms to make data flows seamlessly between them. These mechanisms are ETL and a data communication infrastructure. The ETL provides functions for data consolidation and the data communication infrastructure provides paths for data to travel between systems. There already exist many ETL packages, either the free ones from the open sources or the proprietary ones.

This research takes Bandung State Polytechnic and takes one aspect of its functional areas, that is education program planning, as a case study for implementing the ERP. However, the same method of implementation could be extended for other aspects. This method could also be implemented in other HE institutions which have similar conditions.

## REFERENCES

1. Swartz, D and Orgill, K. "Higher Education ERP: Lessons Learned – Using this framework for ERP could save your university millions of dollars". *EDUCAUSE QUARTERLY* • Number 2, 2001.
2. Davis, M. J. and Huang, Z. "ERP in Higher Education: A Case Study of SAP and Campus Management." *Issues in Information Systems*, Volume VIII, No. 1. 2007
3. Abugabah, A and Sanzogni, L. "Enterprise Resource Planning (ERP) System in Higher Education: A literature Review and Implications". *International Journal of Human and Social Sciences* 5:6. 2010
4. Majed Al-Mashari. "Enterprise resource planning (ERP) systems: a research agenda". *Industrial Management & Data Systems*, 103/1 [2003] 22-27, # MCB UP Limited, [ISSN 0263-5577]. 2003.
5. Chikofsky, E.J.; J.H. Cross II. "Reverse Engineering and Design Recovery: A Taxonomy in IEEE Software". *IEEE Computer Society*: January 1990. pp13–17.
6. Warden, R. "Software Reuse and Reverse Engineering in Practice". London, England: Chapman & Hall. 1992. pp.283–305
7. Zinovy Radovilsky. "Enterprise Resource Planning (ERP)". *The Internet Encyclopedia*, Volume I. John Wiley and Son. New Jersey, 2004.
8. Vincent Rainardi. "Building a Data Warehouse With Examples in SQL Server". Springer-Verlag New York, Inc. 2008
9. Semiawan, T. "Pemodelan dan Penerapan Pengelolaan Sumber Daya Terpadu untuk suatu "Enterprise" Perguruan Tinggi – Studi Kasus: Politeknik Negeri Bandung". *Laporan Penelitian Hibah Bersaing*. Politeknik Negeri Bandung, Bandung. 2013.